Recent Developments in Size-Sorting Trawl Gear for Northern Shrimp in the Gulf of Maine

ASMFC Northern Shrimp Technical Committee

November 5, 2010

Introduction

During an emergency meeting of the Atlantic States Marine Fisheries Commission (ASMFC) Northern Shrimp Section in April 2010, the Section asked the ASMFC northern shrimp technical committee (TC) to meet with shrimp gear researchers to discuss recent developments in shrimp trawl gear in the Gulf of Maine, in particular, innovations that reduce the catches of smaller shrimp. The ASMFC shrimp section manages the Gulf of Maine (GOM) northern shrimp (*Pandalus borealis*) fishery through cooperation with the states of Maine, Massachusetts, and New Hampshire.

The TC and Maine DMR asked Maine Sea Grant and Marine Extension Team member Dana Morse to help organize a meeting, which was held September 23, 2010 at the Gulf of Maine Research Institute in Portland. The meeting was open to the public and widely advertised to the shrimp fishing industry (see Appendix B).

Statement of the Problem

Although there is general agreement that catching small shrimp is undesirable, the problem has not been clearly defined or evaluated. What is a "small" shrimp? How many are caught in the GOM fishery? What are the consequences, biologically and economically?

Northern shrimp are protandric hermaphrodites, generally maturing and functioning as males at about age 2.5, then transitioning to female and spawning as females at about age 3.5 and again the following year. Shrimp in the GOM generally don't live past the age of five or six. At 22 mm carapace length, most shrimp are adult females and fully recruited to the fishery (ASMFC 2004), although some males grow to 25 mm or more (ASMFC 2009, Fig 12). For the purposes

of this report, shrimp smaller than 22 mm will be defined as “small”. This report will also focus only on trawl gear; in recent years about 15% of GOM landings have been by trappers.

Catches of small shrimp vary greatly from season to season. For instance, the 2009 GOM fishery, which ran from December 1, 2008 to May 29, 2009, but which virtually ended the second week of April, caught an estimated 16.7 million small shrimp, which was about 10% of the total catch in numbers. On the other hand, the 2007 fishery (December 1, 2006 – April 30, 2007) caught an estimated 109.6 million small shrimp, which was about 26% of that year’s catch (ASMFC 2009, data for Fig. 5). The average count per pound (from Maine trawl port samples) for 2009 was 42, while for 2007 it was 55 (ME DMR unpublished data).

Several factors influence the size of individual shrimp in catches: gear configuration, time of year, location and depth, the migratory behavior of the female shrimp (which separate from the smaller males by coming inshore to hatch eggs during January to March), interactions with other species, and, perhaps most importantly, the underlying size structure of the population. During the 2009 “clean” fishery, the large, assumed 5-year-old female shrimp were from a very dominant (large) year class (2004), while the male year class (2006) was very weak. Conversely, in 2007, the 3-year-old year class (again, 2004) was very strong compared with the female year classes (2003 and 2002) (ASMFC 2009).

It is well documented that small shrimp are more likely to be encountered during the spring (and summer) months, when the fishery is more likely to be conducted in deeper water where the population of large females and small males is mixed, relative to the inshore winter fishery that targets the large females as they migrate inshore (Clark et al 2000). Figure 1 shows the distribution of catches by sex and development stage by month for the 2007 fishery (ASMFC 2007, Fig. 1b)

The TC annually estimates fishing mortality (F) rates for various scenarios of catch. For the 2007 fishery, a reduction by 50% of the shrimp < 22mm in numbers would have reduced overall catches by 13% in numbers, lowering the fishing mortality rate from an estimated F=0.1747 (ASMFC 2010) to F=0.1498 and exploitation from 14% to 12%. Greater reductions in F could

have been achieved in other, “mixier”, years, for instance 2001, in which < 22 mm shrimp were 38% of the catch in numbers. On the other hand, in 2009, a 50% reduction in < 22 mm shrimp would only have lowered F from an estimated 0.1182 to 0.1120 and exploitation from 9.9% to 9.4%.

Results from the Meeting

The meeting attendees are listed in Appendix A. The meeting was well attended by gear researchers and shrimp biologists from the region, and lightly attended by industry members. Gear researchers included trawlers Kelo Pinkham, Gary Libby, Dr. Pingguo He, Dr. Ken La Valley, and Steve Eayrs, who were all invited speakers. Steve Parkes, from the Cape Ann Fresh Catch CSA, also spoke about market issues.

Double (Dual) Grate systems:

Dr. Pingguo He spoke about his experiments involving a “topless” trawl to reduce finfish bycatch, and a double grate system to reduce catches of small shrimp. His work has been peer reviewed and published, and more information about the size-sorting grid (double grate system) is available in He and Balzano, 2007. A size-sorting grate with funnel in front of the Nordmøre grate, and another without the funnel, were tested (see Figure 2). The gear with the funnel increased mean size and reduced counts in 13 of 14 paired (with standard gear controls) 1-hr tows between mid-March and late June 2006. Counts per pound were reduced from an average of 87 to 67. The gear without the funnel also increased mean size and reduced counts, in 10 of 11 paired tows, and counts per pound were reduced from an average of 79 to 61. The gear without the funnel reduced overall catch by about 15%, and with the funnel, by 39%.

Unfortunately, there were no fishermen present at the meeting who had used either of these double grate systems. A couple of those present suggested that they might be difficult to handle. However, the TC later met with one of the fishermen who worked with Dr. He, who assured us that the system is not difficult or dangerous to use. He has used it himself commercially, but is not currently using it because there is no incentive to do so. Since any gear that reduces small

shrimp will reduce the overall catch volume, harvesters will lose money using them unless there is a monetary reward for a catch with larger shrimp.

Combination (Modified) Grates (Single Grid Sytems):

Gary Libby and Kelo Pinkham described single grates they have used that combine the shrimp-size-sorting grid and the Nordmøre fish-sorting grid into one unit. There is a diagram (provided by Ken La Valley) of Gary's grid with non-parallel (tapered) bar spacing in Figure 3. Some of Kelo's experimental work is described in Pinkham et al 2006. His combination grate, combined with 1¾" knotless square mesh in the cod end, performed significantly better than control gear. Video showed that small shrimp escaping through the grid were still alive. Kelo does not usually get a better price for his shrimp, but in years when the market was weak, he said it helped him attain a market when other fishermen were not able to sell. Gary described the Port Clyde CSF (Community Supported Fishery), and how using the tapered-bar grate, combined with a topless trawl, has enabled their fishery to attract a local market. The TC has not been able to find any scientific evaluation of this particular tapered bar grid.

Distribution:

Dr. Ken La Valley (University of NH Sea Grant) also spoke at the meeting. He has been distributing both the dual grid and the single grid with tapered bar spacing to GOM harvesters. He has found that both systems generally improve (reduce) counts per pound by about 10 counts. He has distributed about 15 dual grid systems and about 10 of the tapered grids. Ken may be available to hold workshops on the gear if needed, and also has information on gear costs.

Other Gear

Other developments in shrimp gear were discussed at the meeting or are described in the literature, including a topless trawl, rope grids, square mesh in the cod end, square mesh in the lengthening piece, and various configurations of single and double grid systems. The Pinkham et al 2006 paper describes 15 different grid configurations. None of them are identical to those that seem to be the most favored: the dual grid, and the tapered single grid described above. Steve Eayrs also spoke about a study that recently confirmed the fish-sorting capability of the Nordmøre grate.

Ready for Prime Time?

The TC finds that it is impossible to identify one best gear for achieving reductions in small shrimp. Few of the gears currently in use have been compared side-by-side, and even if they were, the findings might only apply for that particular location, time of year, or shrimp population structure. Also, the technical papers available do not evaluate success in the same way, and so, are not comparable: He and Balzano reported success as significant reductions in count per pound, while Pinkham et al reported success as significant reductions in the numbers of shrimp < 22mm.

Almost everyone at the meeting felt that various configurations work, but may not be necessary during certain parts of the season, and some are better than others in certain locations or situations. Some configurations may not work well if lobster traps are encountered. Others work better to reduce herring bycatch, others are better for flatfish. There is still a lot of room for further refinements. No one spoke in favor of making their use mandatory. However, there was some discussion about creating incentives for the industry to improve size-selectivity, either by a maximum count-per-pound rule, or by market (economic) incentives. Steve Parkes spoke about the growing CSF movement and other "green" initiatives, which may create market incentives for high-quality shrimp.

Recommendation

Small shrimp, especially in the spring (and summer) fisheries, have been a known problem for a long time. There will be many small shrimp available to the 2011 fishery (ASMFC 2010), and this would be a good year to act.

The TC finds that successful gear strategies for reducing catches of small shrimp exist, and recommends that managers encourage their further development, evaluation, and adoption. This is not the time to put specific restrictive gear language in place, but it is time to give the industry incentives to improve.

Literature Cited:

Atlantic States Marine Fisheries Commission. 2004. Amendment 1 to the interstate fishery management plan for northern shrimp. Fish. Man. Rpt. No. 42. online at http://www.asmfc.org/northernShrimp.htm.

Atlantic States Marine Fisheries Commission. 2009 and annually. Assessment report for Gulf of Maine northern shrimp. online at http://www.asmfc.org/northernShrimp.htm.

Atlantic States Marine Fisheries Commission. 2010. Assessment report for Gulf of Maine northern shrimp. In press.

Clark, S.H., S.X. Cadrin, D.F. Schick, P.J. Diodati, M.P. Armstrong, and D. McCarron. 2000. The Gulf of Maine northern shrimp (Pandalus borealis) fishery: a review of the record. J. Northw. Atl. Fish. Sci. 27: 193-226.He, P., & V. Balzano. 2007. Reducing small shrimps in the Gulf of Maine pink shrimp fishery with a new size-sorting grid system. ICES J. Mar. Sci. 64: 1551-1557.

He, P., & V. Balzano. (2007). Reducing small shrimps in the Gulf of Maine pink shrimp fishery with a new size-sorting grid system. ICES J. Mar. Sci. 64: 1551-1557.

Pinkham, Schick, and White. 2006. Improving the size selectivity for northern shrimp through use of a combination of a modified Nordmøre grate and square mesh. NEC. 109 pp, available online at http://www.northeastconsortium.org/projects.shtml

Figures:

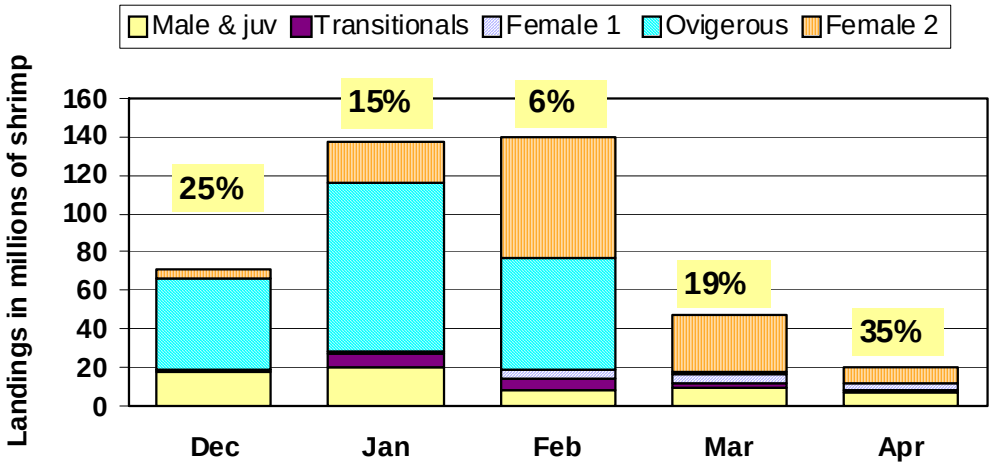

Figure 1. Gulf of Maine northern shrimp landings in millions of shrimp by month and development stage in the 2007 fishing season. Percents are % male & juvenile.

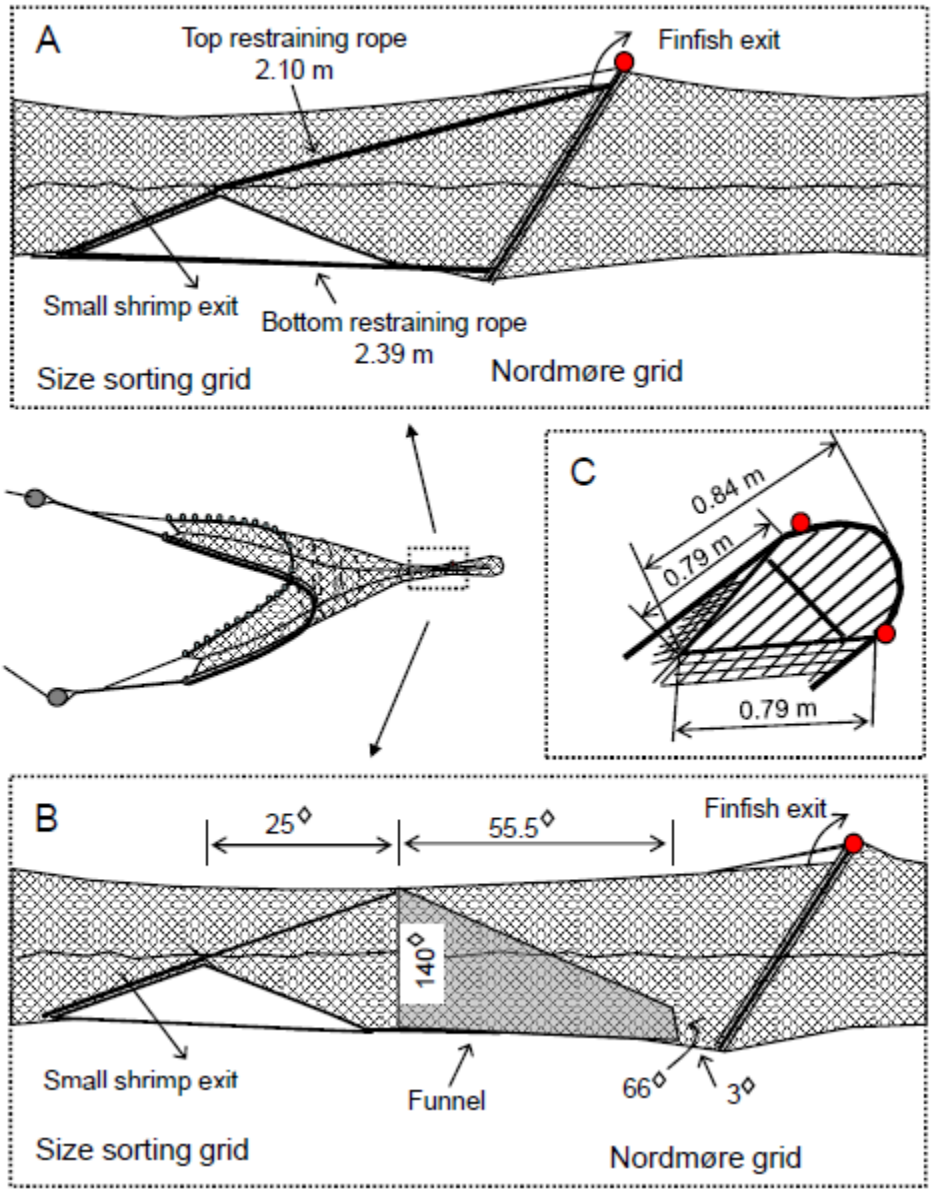

Figure 2. Two size-sorting grid devices tested by He and Balzano (2007). A: No Funnel. B: With Funnel. C: Details of fish exit

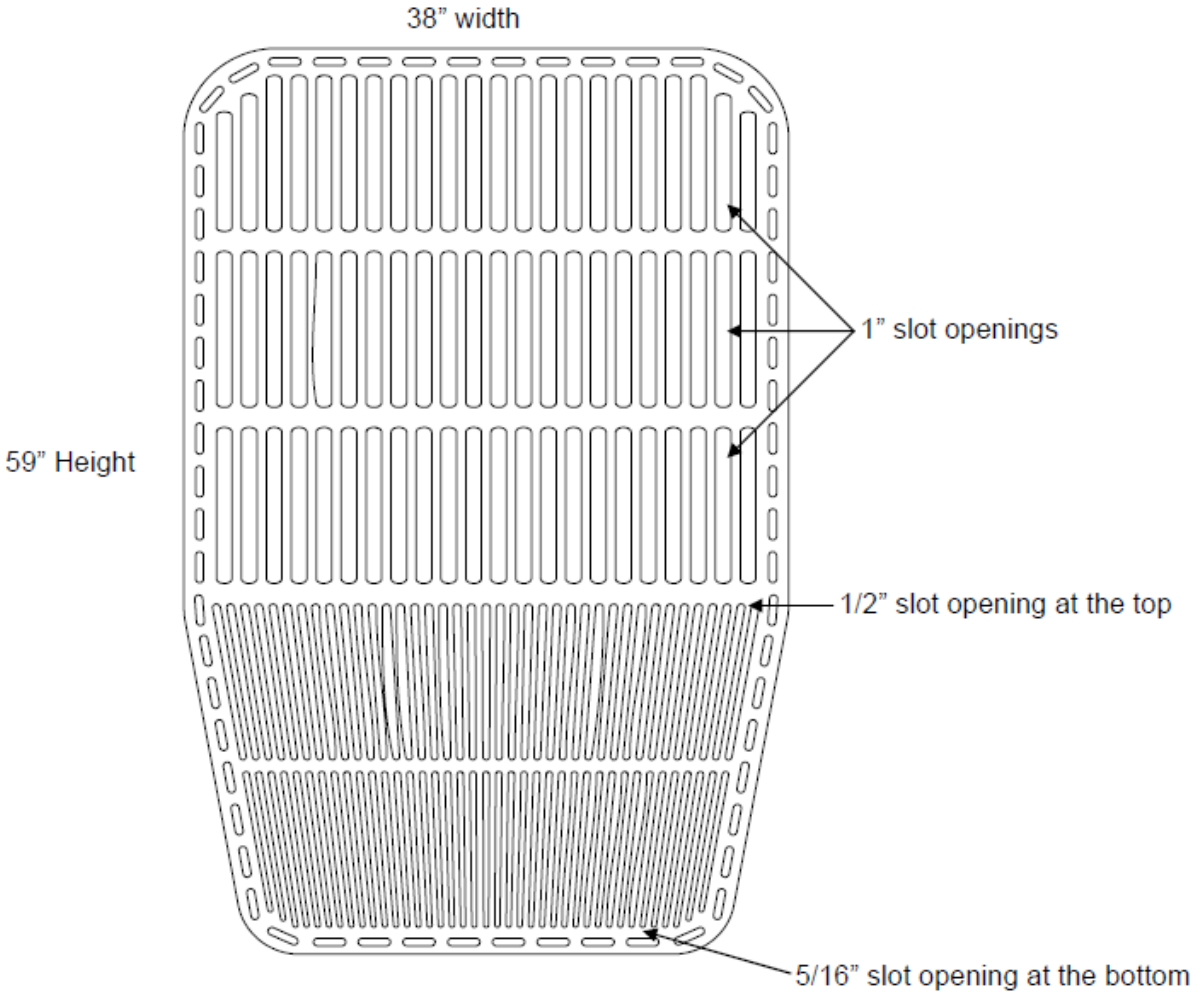

Figure 3. Combination grid with non-parallel size-sorting bars, distributed by Ken La Valley and used by Gary Libby.

Appendix A: Shrimp Gear Meeting Notes, Meeting September 23, 2010, Portland, Maine

Attendees:

Host: Dana Morse (Maine Sea Grant)

Invited speakers:

Kelo Pinkham, Boothbay Harbor

Gary Libby, Port Clyde

Dr. Pingguo He, MA SMAST

Dr. Ken La Valley, UNH Sea Grant

Steve Parkes, Cape Ann Fresh Catch

Steve Eayrs, GMRI

(invited speaker David Goethel was unable to attend)

Others: George Lapointe (ME DMR and ASMFC commissioner), Maggie Hunter (ME DMR and ASMFC northern shrimp technical committee (TC) chair), Les White (ME DMR), Col. Joe Fessenden (ME DMR Marine Patrol Chief), Jessica Fischer (NH Fish & Game and TC member), Kelly Whitmore (MA DMF and TC member) and Paul Diodati (MA DMR director and ASMFC commissioner), Dennis Damon (ME Senator and ASMFC commissioner), Shelly Tallack (GMRI), Rachel Feeney (NH NEC), Cliff Goudy (MIT), Jason Clermont and Dave Martin (NE Aquarium), Steve Robbins (Stonington Co-op), Trawlers: Newbold Varian, Rick Trundy, Dick Bridges, more.

Appendix B: from http://www.maine.gov/dmr/rm/shrimp/gearmeeting10.htm

Meeting on Recent Advances in Fishing Gear for Northern Shrimp

Time: 1 - 4 pm, September 23, 2010
Place: TD Bank Board Room (3rd Floor), Gulf of Maine Research Inst, Portland, Maine (directions here)
Who's invited: Everyone, particularly shrimp harvesters, buyers, scientists, and fishery managers from ME, MA, and NH
Registration: Free, but please RSVP to Dana Morse, below
Hosted by: Maine DMR and Maine Sea Grant

Background:

There have been several recent research projects to test trawl gear modifications that might reduce the catch of smaller shrimp, and/or reduce the bycatch of finfish. These include a combination grate, a double grate, and a topless trawl.

Last spring, the ASMFC Northern Shrimp Section decided to close the 2009-10 shrimp fishing season early, in part because the shrimp caught in the spring were significantly smaller than those caught earlier in the season. This was nothing new, but got a lot of attention. The Section asked the Technical Committee to meet with researchers to discuss solutions.

In early November 2010, the Section will develop its management plan for Northern Shrimp for the coming fishing season. Prior to this, the Technical Committee will review research done in recent years to reduce bycatch of undersized shrimp and non-target species, and may make a recommendation to the Section. This meeting will allow fishermen, researchers and others to discuss their work with members of the Technical Committee, so that their results may be added to the information considered in management.

Purpose:

Our purpose will be to hear from the researchers and fishermen who have experimented with various gear configurations, and get their recommendations on:

1. Whether/when/where small shrimp are a problem (both biologically or economically), and
2. If so, whether recent gear research offers solutions, and
3. If so, whether we are ready to discuss management regulations or pilot programs, and
4. What, if any, further research might be useful

Agenda:

There will be presentations from several researchers and fishermen, followed by open discussion. The presenters include:

Kelo Pinkham – Fisherman (F/V Jeanne C) Boothbay, Maine
Dr. Pingguo He – SMAST, New Bedford, MA
David Goethel – Fisherman (F/V Ellen Diane) NH [Dave was unable to attend]
Gary Libby – Fisherman, Port Clyde, ME
Ken LaValley – UNH Sea Grant, Durham, NH
Steve Parkes – Cape Ann Fresh Catch/Gloucester Fishermen's Wives Assoc., MA

Registration:

The meeting is free and open to the public, but **please contact Dana Morse** below if you plan to attend, because space is limited to about 50.

More Information:

For more information, please contact:

- Dana Morse (Sea Grant & Univ. of Maine Cooperative Extension) Email: dana.morse@maine.edu Phone: (207) 563-3146 x205
- Maggie Hunter (DMR) Email: margaret.hunter@maine.gov Phone: (207) 633-9541

Technical Reports:

- Pinkham, Schick, and White. 2006. Improving the Size Selectivity for Northern Shrimp Through Use of a Combination of a Modified Nordmore Grate and Square Mesh. NEC. - pdf file, 109 pages, 4MB | Summary table - pdf file, 1 page, 16kb
- He and Balzano. 2009. Design and Test a Size-sorting Grid to Reduce Small Shrimps in the Northern Shrimp Fishery In Gulf of Maine. NEC. - pdf file, 31 pages, 1.2 MB
- He, Goethal, and Smith. 2007. Design and test of a Topless Shrimp Trawl, to Reduce Pelagic Fish Bycatch in the Gulf of Maine Pink Shrimp Fishery. *J. Northw. Atl. Fish Sci.* - pdf file, 9 pages, 859 kb
- Eayers, Stephens, and Raymond. 2009. A Contemporary Assessment of the Bycatch of Regulated Species and the Nordmore Grate in the Northern Shrimp Fishery. NEC. - pdf file, 43 pages, 378 kb
- ASMFC. 2004. Amendment 1 to the Interstate Fishery Management Plan for Northern Shrimp. - pdf file, 84 pages, 1.7 MB

Appendix C: From http://www.seagrant.umaine.edu/research/projects/dv/dual-grate-system-and-shrimp-fishery

DV-08-016 Technology transfer of the dual grate system to the Northern shrimp fishery

Ken La Valley

New Hampshire Sea Grant

219 Nesmith Hall

131 Main Street

Durham, NH 03824

603.862.4343

ken.lavalley@unh.edu

Northern shrimp stocks are healthy, but due to historic declines and market volatility, regional shore-side infrastructure (i.e., processing facilities) is reduced. To compete in this market, fishermen have tried to improve quality and consistency to both increase local demand for fresh product and obtain higher prices for their catch. Since larger shrimp fetch the highest price, fishermen are targeting catches of larger shrimp, while striving to eliminate the bycatch and discard of non-target fish. The dual-grid system and the non-parallel grate are two strategies that have been shown to significantly enhance size selectivity of shrimp and reduce the catch of non-target species. Sea Grant partnered with the National Marine Fisheries Service to fund the manufacture of 10 non-parallel grates and six dual-grid sets for the industry. As a result, 20 industry members (as opposed to two who used it in the 2005-2006 fishing season) acquired new gear and approximately 15% of vessels using shrimp trawls used the conservation gear in 2008.

Ken La Valley and his research team at New Hampshire Sea Grant/Cooperative Extension anticipate that, as the market demand for local shrimp increases, shore-side processing facilities will return and all gear that was provided, in part, by this project will be used during the 2009 – 2010 shrimp season.